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(54) **FUEL CELL COOLANT FLOWFIELD CONFIGURATION**

STRÖMUNGSFELDKONFIGURATION FÜR EIN BRENNSTOFFZELLENKÜHLMITTEL

CONFIGURATION DU CHAMP D'ÉCOULEMENT DU FLUIDE DE REFROIDISSEMENT D'UNE PILE À COMBUSTIBLE

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Description

[0001] This invention was made with government support under Contract No. CA-04-7003-00 awarded by the Department of Transportation/Federal Transit Agency. The Government therefore has certain rights in this invention

BACKGROUND

[0002] Typical fuel cell arrangements include multiple fuel cells placed together in a cell stack assembly (CSA). Each fuel cell generally includes an anode, a cathode, and a membrane between the anode and the cathode. A cathode reactant, such as oxygen, and an anode reactant, such as hydrogen, are used in an electrochemical reaction at the membrane to produce electrical energy.

[0003] CSA durability can be limited by a variety of decay mechanisms or factors. For example, voltage cycling may cause performance decay over time. Local membrane humidity cycling may cause the membrane to wear out. Both of these types of cycling may occur in response to changes in load or power demand. Another source of CSA decay is an elevated operating temperature. Higher operating temperatures tend to be associated with higher decay rates in CSA performance. A number of approaches have been taken to mitigate CSA decay caused by elevated operating temperatures.

SUMMARY

[0004] An exemplary fuel cell assembly includes a first electrode, a second electrode, and a membrane between the electrodes. A reactant distribution plate includes at least one reactant flow channel extending from a reactant inlet near an edge of the reactant distribution plate to an outlet. A coolant supply channel near the at least one reactant flow channel extends from a coolant inlet, which is spaced from the reactant inlet, to a coolant outlet. The coolant supply channel includes a first portion between the coolant inlet and a second portion near the reactant inlet. The first portion facilitates coolant flow from the coolant inlet directly toward the second portion. The second portion includes a plurality of channel sections that collectively facilitate coolant flow in a plurality of directions along the second portion near the reactant inlet. The coolant supply channel includes a third portion between the second portion and the coolant outlet, wherein the coolant supply channel is established on at least one side of the fluid distribution plate and the second portion occupies approximately one quadrant of the plate that includes a corner of the plate that is near the reactant inlet. Particular embodiments may include any of the following optional features, alone or in combination.

The channel sections of the second portion may be arranged in a serpentine pattern.

The channel sections of the second portion may direct the coolant flow in a first direction a plurality of times along the second portion and in a second, opposite direction at least once along the second portion.

[0005] The first portion may have a single channel portion that directs the coolant flow in a single direction from the coolant inlet directly to a first one of the channel sections of the second portion.

The coolant supply channel may be established on at least one side of the fluid distribution plate and the second portion extends parallel to one edge of the plate across substantially an entire dimension of the plate along the one edge.

The first portion of the coolant channel may direct coolant flow in a single direction generally perpendicular to the one edge of the plate and the second portion directs coolant flow in at least two directions that are generally parallel to the one edge of the plate.

[0006] The first portion of the coolant channel may direct coolant flow in a single direction from the coolant inlet directly toward the corner of the plate and the second portion directs coolant flow in at least the single direction and an opposite direction that is generally parallel to the single direction.

The third portion of the coolant channel may direct coolant in a direction generally perpendicular to the single direction of the first portion.

[0007] Further, the fuel cell assembly may comprise at least one second coolant supply channel that is distinct from the coolant supply channel and wherein the at least one second coolant flow channel directs coolant flow in a different pattern than the coolant supply channel.

The reactant plate may comprise a porous water transport plate.

The water transport plate may be micro-porous and hydrophilic.

[0008] An exemplary method of cooling the before defined fuel cell includes directing coolant through a coolant supply channel near at least one reactant flow channel. The coolant supply channel extends from a coolant inlet spaced from a reactant inlet to a coolant outlet. The coolant supply channel includes a first portion between the coolant inlet and a second portion near the reactant inlet. The first portion facilitates coolant flow from the coolant inlet directly toward the second portion. The second portion includes a plurality of channel sections that collectively facilitate coolant flow in a plurality of directions along the second portion near the reactant inlet. The coolant supply channel includes a third portion between the second portion and the coolant outlet. The coolant supply channel is established on at least one side of the fluid distribution plate and the second portion occupies approximately one quadrant of the plate that includes a corner of the plate that is near the reactant inlet. Particular embodiments may include any of the following optional features, alone or in combination.

[0009] The channel sections of the second portion may direct the coolant flow in a first direction a plurality of times along the second portion and in a second, opposite direction at least once along the second portion.

The first portion may have a single channel portion that directs the coolant flow in a single direction from the coolant inlet directly to a first one of the channel sections of the second portion.

The coolant supply channel may be established on at least one side of a plate and the second portion extends parallel to one edge of the plate across substantially an entire dimension of the plate along one edge.

The first portion of the coolant channel may direct coolant flow in a single direction generally perpendicular to the one edge of the plate and the second portion directs coolant flow in at least two directions that are generally parallel to the one edge of the plate.

[0010] The first portion of the coolant channel may direct coolant flow in a single direction from the coolant inlet directly toward the corner of the plate and the second portion directs coolant flow in at least the single direction and an opposite direction that is generally parallel to the single direction.

Further, the fuel cell assembly may comprise at least one second coolant flow channel that is distinct from the coolant supply channel and wherein the at least one second coolant flow channel directs coolant flow in a different pattern than the coolant supply channel.

[0011] These and other features of disclosed examples can be understood from the following description and the accompanying drawings, which can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWING

[0012]

Figure 1 illustrates a schematic view of selected components of an example fuel cell assembly.

Figure 2 illustrates a schematic view of an example fluid flow diagram.

Figure 3 illustrates another example schematic view of a fluid flow diagram

Figure 4 illustrates an example coolant flowfield.

Figure 5 illustrates another example coolant flowfield embodiment.

Figure 6 illustrates the example coolant flowfield embodiment according to the invention.

DETAILED DESCRIPTION

[0013] Figure 1 illustrates a schematic view of selected components of an example fuel cell assembly 20 including a first electrode 22, such as a cathode, a second electrode 24, such as an anode, and a membrane 26 located between the first electrode 22 and the second electrode 24. A first gas diffusion layer 28 is located adjacent the first electrode 22 and a second gas diffusion layer 30 is located adjacent the second electrode 24. The first and second gas diffusion layers 28, 30 are located on an opposite side of the first and second electrodes 22, 24, respectively, from the membrane 26.

[0014] An example first fluid distribution plate assembly 32 includes first reactant flow channels 34 located on a first side 36 of the first fluid distribution plate assembly 32 and coolant supply channels 38 located on a second, opposite side 40 of the first fluid distribution plate assembly 32. The first reactant flow channels 34 are located adjacent the first gas diffusion layer 28 and are configured to accept air or pure oxygen. The coolant supply channels 38 are configured to direct a coolant, such as water, to achieve a desired cooling effect in the fuel cell assembly 20.

[0015] In some examples, the first fluid distribution plate assembly 32 is micro-porous and hydrophilic.

[0016] A second fluid distribution plate assembly 42, such as a porous water transport plate, is located adjacent the second gas diffusion layer 30 on an opposite side of the second gas diffusion layer 30 from the second electrode 24. The second fluid distribution plate assembly 42 includes second reactant flow channels 44 located on a first side 46 and configured to distribute a fuel, such as hydrogen.

[0017] In this example, the second fluid distribution plate assembly 42 is micro-porous and hydrophilic.

[0018] Figure 2 schematically illustrates an example fluid flow pattern or design for an embodiment of the fuel cell assembly 20. A coolant inlet region 50 is located along a first edge 52 near an intersection of the first edge 52 and a second edge 54 (e.g., near the corner of the plate) of the fuel cell assembly 20. In this example, the inlet region 50 leads into the channels 38 on the first fluid distribution plate assembly 32. The coolant inlet region 50 is in fluid communication with the coolant supply channels 38 and a coolant outlet region 56. The coolant outlet region 56 is located on a third edge 58 of the assembly 20 and in particular the edge 58 of the first fluid distribution plate assembly 32 near an intersection of the third edge 58 and a fourth edge 60.

[0019] A first reactant inlet region 62 is located along the third edge 58. The first reactant inlet region 62 is in fluid communication with the first reactant flow channels 34 (Figure 1) and a first reactant outlet region 64 located adjacent the first edge 52. The first reactant inlet region 62 in this example is on an edge of the first fluid distribution plate assembly 32. The first reactant flows in a single pass pattern in this example.

[0020] A second reactant flows in a two-pass flow pattern in this example. A second reactant inlet region 66 is located on the second fluid distribution plate assembly 42 adjacent the second edge 54 and near an intersection of the second edge 54 and the third edge 58. The second reactant inlet region 66 is in fluid communication with the second reactant flow channels 44 and a second reactant outlet region 68. The second reactant outlet region 68 is

located adjacent the second edge 54 of the first fluid distribution plate assembly 32 and near an intersection of the first edge 52 and the second edge 54. In this example, the second reactant flow channels 44 extend the length of the fuel cell assembly 20 to a manifold 70 along the edge 60. The manifold 70 directs the second reactant towards the second reactant outlet region 68, which is on the edge 54 in this example.

[0021] Figure 3 illustrates a schematic view of another example fluid flow pattern or design for another embodiment of the fuel cell assembly 20, similar to the schematic view shown in Figure 2. In Figure 3 both reactants follow a two-pass path across the respective plates. The first reactant inlet region 62 and the coolant inlet region 50 are located along the first edge 52 of the first fluid distribution plate assembly 32. At least one of the first reactant flow channels 34 extends from the first reactant inlet region 62 along the first edge 52 to a manifold 72 located along the third edge 58. The first reactant is redirected by the manifold 72 from the third edge 58 through at least one more of the first reactant flow channels 34 to the first reactant outlet region 64 along the first edge 52.

[0022] Figure 4 illustrates an example coolant flowfield 80 including the coolant supply channels 38 located on the first fluid distribution plate assembly 32. The example coolant flowfield 80 includes a first coolant channel 38a having a first portion 82, a second portion 84, and a third portion 86.

[0023] The first portion 82 of the first coolant supply channel 38a extends between the coolant inlet region 50 and the second portion 84. The first portion 82 facilitates coolant flow from the coolant inlet region 50 directly toward the second portion 84. The first portion 82 includes at least one channel portion that directs the coolant flow in a single direction from the coolant inlet region 50 directly to the second portion 84. The coolant flow in the single direction is generally perpendicular to the first edge 52 of the first fluid distribution plate assembly 32, in this example.

[0024] The second portion 84 is located near the second reactant inlet region 66 and the first reactant inlet region 62 and includes a plurality of channel sections that collectively facilitate coolant flow in a plurality of directions along the second portion 84. The first direction 88 and the second direction 90 are generally parallel to the third edge 58 of the first fluid distribution plate assembly 32. The channel sections of the second portion 84 are arranged in a serpentine pattern and direct the coolant flow in a first direction 88 a plurality of times and in a second, opposite direction 90 at least once. The second portion 84 extends across substantially an entire dimension of the first fluid distribution plate assembly 32 parallel to the third edge 58 of the first fluid distribution plate assembly 32.

[0025] The channel 38a, and in particular the second channel portion 84, ensures that a sufficient amount of coolant reaches the portion of the fuel cell assembly 20 that includes the reactant inlet 62. That region or portion may experience high temperatures because of the configuration of the inlets 62, 66 and 50. The channel 38a is configured to direct coolant directly toward the second portion 84 so that the temperature of the coolant is as low as possible in that portion of the channel. The multiple passes of the coolant in the second portion 84 provides concentrated cooling in the vicinity of the reactant inlets 62 and 66.

[0026] The third portion 86 of the first coolant supply channel 38a extends between the second portion 84 and the coolant outlet region 56 to facilitate flow of coolant out of the first fluid distribution plate assembly 32.

[0027] The coolant flowfield 80 includes at least one second coolant supply channel 38b that is distinct from the first coolant supply channel 38a. The second coolant supply channels 38b direct coolant flow in a different pattern than the first coolant supply channel 38a. The second coolant supply channels 38b extend from the coolant inlet region 50 and include multiple passes in the first direction 88 and in the second direction 90. The second coolant supply channels 38b extend in a serpentine pattern until they eventually end at the coolant outlet region 56.

[0028] Figure 5 illustrates an example coolant flowfield 180 according to another example embodiment. The first coolant supply channel 38a is located on the first fluid distribution plate assembly 32. The example coolant flowfield 180 includes a first portion 182, a second portion 184, and a third portion 186. The coolant flowfield 180 is symmetric so that coolant flow follows in an identical pattern whether the first fluid distribution plate assembly 32 is in the illustrated orientation or is rotated 180 degrees about a line perpendicular to the plane of plate 32 such that the coolant inlet region 50 and the coolant outlet region 56 are reversed. Since the coolant flowfield 180 is symmetric, the possibility of incorrectly installing the first fluid distribution plate assembly 32 into the fuel cell assembly 20 greatly decreases.

[0029] The first portion 182 includes a channel 38a having a channel portion that directs the coolant flow in a single direction from the coolant inlet region 50 directly to the second portion 184. The first portion 182 of the first coolant supply channel 38a directs coolant flow in a single direction generally perpendicular to the first edge 52 of the first fluid distribution plate assembly 32.

[0030] The second portion 184 is arranged in a serpentine pattern that directs the coolant flow in a first direction 188 a plurality of times along the second portion 184 and in a second opposite direction 190 at least once along the second portion 184. The second portion 184 is located adjacent the second reactant inlet region 66 and the first reactant inlet region 62 and directs coolant flow in at least two directions that are generally parallel to the first edge 52 and the third edge 58 of the first fluid distribution plate assembly 32. The coolant flow in the first portion 182 is generally perpendicular to the coolant flow the second portion 184.

[0031] The third portion 186 of the first coolant supply channel 38a extends between the second portion 184

and the coolant outlet region 56 to facilitate flow of coolant out of the first fluid distribution plate assembly 32.

[0032] The coolant flowfield 180 includes at least one second coolant supply channel 38b that is distinct from the first coolant supply channel 38a. The second coolant supply channels 38b follow a similar pattern to that of the channel 38b. In this example, there are two other portions 192. One of the other portions 192 is located in a central portion of the first fluid distribution plate assembly 32 and the other is located adjacent the first edge 52 of the first fluid distribution plate assembly 32.

[0033] Figure 6 illustrates an example coolant flowfield 280 according to the invention. The first coolant supply channel 38a is shown on the first fluid distribution plate assembly 32. The example coolant flowfield 280 includes a first portion 282, a second portion 284, and a third portion 286.

[0034] The first portion 282 includes a single channel portion that directs the coolant flow in a single direction from the coolant inlet region 50 directly to at least one of the first coolant supply channels 38a of the second portion 284. The first portion 282 of the first coolant supply channel 38a directs coolant flow in a single direction 283 generally perpendicular to the first edge 52 of the first fluid distribution plate assembly 32.

[0035] The second portion 284 occupies approximately one quadrant of the first fluid distribution plate assembly 32 that includes a corner of the first fluid distribution plate assembly 32 that is near the second reactant inlet region 66. The first portion 282 of the coolant supply channel 38a directs coolant flow from the coolant inlet region 50 directly toward the corner of the first fluid distribution plate assembly 32 where the second edge 54 meets the third edge 58. The second portion 284 includes channel portions in a serpentine pattern for directing coolant flow multiple times near the inlet region 66. The coolant flows directly to the second portion 284 and flows along multiple channel portions to provide a significant portion of the cooling capacity in the vicinity of the inlet region 66.

[0036] The third portion 286 of the coolant supply channel 38a extends between the second portion 284 and the coolant outlet region 56 in a serpentine pattern to facilitate eventual coolant flow out of the first fluid distribution plate assembly 32. The channel portions in the third portion 286 extend generally parallel to the edge 58 of the first fluid distribution plate assembly 32 and perpendicular to the orientation of most of the channel portions of the second portion 284.

[0037] The coolant flowfield 280 includes at least one second coolant supply channel 38b that is distinct from the first coolant supply channel 38a. The second coolant supply channels 38b direct coolant flow in a different pattern than the first coolant supply channel 38a. The second coolant supply channels 38b include a first portion 292 that extends in a serpentine pattern adjacent the first edge 52 of the first fluid distribution plate assembly 32 and along substantially the entire length of the first fluid distribution plate assembly. The second coolant supply channels 38b include a second portion 294 that extends in a serpentine pattern substantially perpendicular the first portion 292 in a central region of the first fluid distribution plate assembly 32. Eventually the channels 38b end at the outlet 56.

[0038] The illustrated examples provide significant, concentrated cooling at the portions of the fluid distribution plates and the fuel cell assembly that may experience significant heat during fuel cell operation. The areas near the reactant inlets may be hotter than others when the coolant inlet locations and flow direction are different than those of the reactant. The illustrated coolant flowfield arrangements protect fuel cell components against localized increased temperatures that otherwise may have a negative effect on performance, durability or both.

[0039] The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The scope of legal protection given to this invention can only be determined by studying the following claims.

Claims

1. A fuel cell assembly, comprising:

a first electrode;
a second electrode;
a membrane between the first electrode and the second electrode;
a fluid distribution plate having at least one reactant flow channel extending from a reactant inlet near one edge of the fluid distribution plate to an outlet; and
a coolant supply channel near the at least one reactant flow channel, the coolant supply channel extending from a coolant inlet spaced from the reactant inlet to a coolant outlet, the coolant supply channel having a first portion between the coolant inlet and a second portion near the reactant inlet, the first portion facilitating coolant flow from the coolant inlet directly toward the second portion, the second portion comprising a plurality of channel sections that collectively facilitate coolant flow in a plurality of directions along the second portion near the reactant inlet, the coolant supply channel having a third portion between the second portion and the coolant outlet,
wherein the coolant supply channel is established on at least one side of the fluid distribution plate and the second portion occupies approximately one quadrant of the plate that includes a corner of the plate that is near the reactant inlet.

2. The fuel cell assembly of claim 1 wherein the channel sections of the second portion are arranged in a serpentine pattern.

3. The fuel cell assembly of claim 1 or 2, wherein the channel sections of the second portion direct the coolant flow in a first direction a plurality of times along the second portion and in a second, opposite direction at least once along the second portion.

4. The fuel cell assembly of any of claim 1 to 3, wherein the first portion has a single channel portion that directs the coolant flow in a single direction from the coolant inlet directly to a first one of the channel sections of the second portion.

5. The fuel cell assembly of any of claims 1 to 4, wherein the first portion of the coolant channel directs coolant flow in a single direction from the coolant inlet directly toward the corner of the plate and the second portion directs coolant flow in at least the single direction and an opposite direction that is generally parallel to the single direction.

6. The fuel cell assembly of claim 5, wherein the third portion of the coolant channel directs coolant in a direction generally perpendicular to the single direction of the first portion.

7. The fuel cell assembly of any of claims 1 to 6, comprising at least one second coolant supply channel that is distinct from the coolant supply channel and wherein the at least one second coolant flow channel directs coolant flow in a different pattern than the coolant supply channel.

8. The fuel cell assembly of claim 7, wherein the reactant plate comprises a porous water transport plate.

9. The fuel cell assembly of claim 8, wherein the water transport plate is micro-porous and hydrophilic.

10. A method of cooling a fuel cell assembly as defined in any of claims 1-9, comprising:

directing coolant through a coolant supply channel near at least one reactant flow channel, the coolant supply channel extending from a coolant inlet spaced from a reactant inlet to a coolant outlet, the coolant supply channel having a first portion between the coolant inlet and a second portion adjacent the reactant inlet, the first portion facilitating coolant flow from the coolant inlet directly toward the second portion, the second portion comprising a plurality of channel sections that collectively facilitate coolant flow in a plurality of directions along the second portion near the reactant inlet, the coolant supply channel having a third portion between the second portion and the coolant outlet, wherein the coolant supply channel is established on at least one side of the fluid distribution plate and the second portion occupies approximately one quadrant of the plate that includes a corner of the plate that is near the reactant inlet.

Patentansprüche

1. Brennstoffzellenahordnung, die Folgendes umfasst:

eine erste Elektrode;
eine zweite Elektrode;
eine Membran zwischen der ersten Elektrode und der zweiten Elektrode;
eine Fluidverteilungsplatte, die mindestens einen Reaktandenströmungskanal aufweist, der sich von einem Reaktandeneinlass nahe einer Kante der Fluidverteilungsplatte zu einem Auslass erstreckt; und
einen Kühlmittelzulaufkanal nahe dem mindestens einen Reaktandenströmungskanal, wobei der Kühlmittelzulaufkanal sich von einem Kühlmitteleinlass, der vom Reaktandeneinlass beabstandet ist, zu einem Kühlmittelauslass erstreckt, wobei der Kühlmittelzulaufkanal einen ersten Abschnitt zwischen dem Kühlmitteleinlass und einem zweiten Abschnitt nahe dem Reaktandeneinlass aufweist, wobei der erste Abschnitt einen Kühlmittelstrom vom Kühlmitteleinlass direkt zum zweiten Abschnitt ermöglicht, wobei der zweite Abschnitt eine Vielzahl von Kanalabschnitten umfasst, die zusammen einen Kühlmittelstrom in eine Vielzahl von Richtungen entlang des zweiten Abschnitts nahe dem Reaktandeneinlass ermöglichen, wobei der Kühlmittelzulaufkanal einen dritten Abschnitt zwischen dem zweiten Abschnitt und dem Kühlmittelauslass aufweist,
wobei der Kühlmittelzulaufkanal auf mindestens einer Seite der Fluidverteilungsplatte eingerichtet ist und der zweite Abschnitt ungefähr einen Quadranten der Platte einnimmt, der eine Ecke der Platte beinhaltet, die sich nahe dem Reaktandeneinlass befindet.

2. Brennstoffzellenanordnung nach Anspruch 1, wobei die Kanalabschnitte des zweiten Abschnitts in einem Serpentinenmuster angeordnet sind.

3. Brennstoffzellenanordnung nach Anspruch 1 oder 2, wobei die Kanalabschnitte des zweiten Abschnitts den Kühlmittelstrom eine Vielzahl von Malen entlang des zweiten Abschnitts in eine erste Richtung und mindestens einmal entlang des zweiten Abschnitts in eine zweite, entgegengesetzte Richtung leiten.

4. Brennstoffzellenanordnung nach einem der Ansprüche 1 bis 3, wobei der erste Abschnitt einen einzelnen Kanalabschnitt aufweist, der den Kühlmittelstrom vom Kühlmitteleinlass in eine einzige Richtung direkt zu einem ersten der Kanalabschnitte des zweiten Abschnitts leitet.

5. Brennstoffzellenanordnung nach einem der Ansprüche 1 bis 4, wobei der erste Abschnitt des Kühlmittelkanals den Kühlmittelstrom vom Kühlmitteleinlass in eine einzelne Richtung direkt zur Ecke der Platte leitet und der zweite Abschnitt den Kühlmittelstrom in mindestens die einzelne Richtung und eine entgegengesetzte Richtung leitet, die im Allgemeinen parallel zur einzelnen Richtung verläuft.

6. Brennstoffzellenanordnung nach Anspruch 5, wobei der dritte Abschnitt des Kühlmittelkanals Kühlmittel in eine Richtung leitet, die im Allgemeinen senkrecht zur einzelnen Richtung des ersten Abschnitts verläuft.

7. Brennstoffzellenanordnung nach einem der Ansprüche 1 bis 6, die mindestens einen zweiten Kühlmittelzulaufkanal umfasst, der sich vom Kühlmittelzulaufkanal unterscheidet, und wobei der mindestens eine zweite Kühlmittelströmungskanal den Kühlmittelstrom in einem anderen Muster als der Kühlmittelzulaufkanal leitet.

8. Brennstoffzellenanordnung nach Anspruch 7, wobei die Reaktandenplatte eine poröse Wassertransportplatte umfasst.

9. Brennstoffzellenanordnung nach Anspruch 8, wobei die Wassertransportplatte mikroporös und hydrophil ist.

10. Verfahren zum Kühlen einer Brennstoffzellenanordnung wie in einem der Ansprüche 1-9 definiert, das Folgendes umfasst:

    Leiten von Kühlmittel durch einen Kühlmittelzulaufkanal nahe dem mindestens einen Reaktandenströmungskanal, wobei der Kühlmittelzulaufkanal sich von einem Kühlmitteleinlass, der von einem Reaktandeneinlass beabstandet ist, zu einem Kühlmittelauslass erstreckt, wobei der Kühlmittelzulaufkanal einen ersten Abschnitt zwischen dem Kühlmitteleinlass und einem zweiten dem Reaktandeneinlass benachbarten Abschnitt aufweist, wobei der erste Abschnitt einen Kühlmittelstrom vom Kühlmitteleinlass direkt zum zweiten Abschnitt ermöglicht, wobei der zweite Abschnitt eine Vielzahl von Kanalabschnitten umfasst, die zusammen einen Kühlmittelstrom in eine Vielzahl von Richtungen entlang des zweiten Abschnitts nahe dem Reaktandeneinlass ermöglichen, wobei der Kühlmittelzulaufkanal einen dritten Abschnitt zwischen dem zweiten Abschnitt und dem Kühlmittelauslass aufweist, wobei der Kühlmittelzulaufkanal auf mindestens einer Seite der Fluidverteilungsplatte eingerichtet ist und der zweite Abschnitt ungefähr einen Quadranten der Platte einnimmt, der eine Ecke der Platte beinhaltet, die sich nahe dem Reaktandeneinlass befindet.

Revendications

1. Ensemble pile à combustible, comprenant :

    une première électrode ;
    une seconde électrode ;
    une membrane entre la première électrode et la seconde électrode ;
    une plaque de distribution de fluide ayant d'au moins un canal de flux de réactif s'étendant depuis une entrée de réactif près d'un bord de la plaque de distribution de fluide jusqu'à une sortie ; et
    un canal d'alimentation en fluide de refroidissement près de l'au moins un canal de flux de réactif, le canal d'alimentation en fluide de refroidissement s'étendant à partir d'une entrée de fluide de refroidissement espacée de l'entrée de réactif jusqu'à une sortie de fluide de refroidissement, le canal d'alimentation en fluide de refroidissement ayant une première portion entre l'entrée de fluide de refroidissement et une deuxième portion près de l'entrée de réactif, la première portion facilitant le flux de fluide de refroidissement depuis l'entrée de fluide de refroidissement directement vers la deuxième portion, la deuxième portion comprenant une pluralité de sections de canal qui facilitent collectivement le flux de fluide de refroidissement dans une pluralité de directions le long de la deuxième portion près de l'entrée de réactif, le canal d'alimentation en fluide de refroidissement ayant une troisième portion entre la deuxième portion et la sortie de fluide de refroidissement,
    dans lequel le canal d'alimentation en fluide de refroidissement est établi sur au moins un côté de la plaque de distribution de fluide et la deuxième portion occupe environ un quadrant de la plaque qui inclut un angle de la plaque qui est près de l'entrée de réactif.

2. Ensemble pile à combustible selon la revendication 1, dans lequel les sections de canal de la deuxième portion sont agencées en un motif sinueux.

3. Ensemble pile à combustible selon la revendication 1 ou 2, dans lequel les sections de canal de la deuxiè-

me portion dirigent le flux de fluide de refroidissement dans un premier sens une pluralité de fois le long de la deuxième portion et dans un second sens opposé au moins une fois le long de la deuxième portion.

4. Ensemble pile à combustible selon l'une quelconque des revendications 1 à 3, dans lequel la première portion a une portion formant canal unique qui dirige le flux de fluide de refroidissement dans un sens unique allant de l'entrée de fluide de refroidissement directement jusqu'à une première des sections de canal de la deuxième portion.

5. Ensemble pile à combustible selon l'une quelconque des revendications 1 à 4, dans lequel la première portion du canal de fluide de refroidissement dirige le flux de fluide de refroidissement dans un sens unique allant de l'entrée de fluide de refroidissement directement vers l'angle de la plaque et la deuxième portion dirige le flux de fluide de refroidissement dans au moins le sens unique et un sens opposé qui est globalement parallèle au sens unique.

6. Ensemble pile à combustible selon la revendication 5, dans lequel la troisième portion du canal de fluide de refroidissement dirige le fluide de refroidissement dans un sens globalement perpendiculaire au sens unique de la première portion.

7. Ensemble pile à combustible selon l'une quelconque des revendications 1 à 6, comprenant
au moins un second canal d'alimentation en fluide de refroidissement qui est distinct du canal d'alimentation en fluide de refroidissement et dans lequel l'au moins un second canal de flux de fluide de refroidissement dirige le flux de fluide de refroidissement dans un motif différent du canal d'alimentation en fluide de refroidissement.

8. Ensemble pile à combustible selon la revendication 7, dans lequel la plaque de réactif comprend une plaque poreuse de transport d'eau.

9. Ensemble pile à combustible selon la revendication 8, dans lequel la plaque de transport d'eau est microporeuse et hydrophile.

10. Procédé de refroidissement d'un ensemble pile à combustible selon l'une quelconque des revendications 1 à 9, comprenant :

l'orientation d'un fluide de refroidissement à travers un canal d'alimentation en fluide de refroidissement près d'au moins un canal de flux de réactif, le canal d'alimentation en fluide de refroidissement s'étendant depuis une entrée de fluide de refroidissement espacée d'une entrée de réactif jusqu'à une sortie de fluide de refroidissement, le canal d'alimentation en fluide de refroidissement ayant une première portion entre l'entrée de fluide de refroidissement et une seconde portion adjacente à l'entrée de réactif, la première portion facilitant le flux de fluide de refroidissement depuis l'entrée de fluide de refroidissement directement vers la deuxième portion, la deuxième portion comprenant une pluralité de sections de canal qui facilitent collectivement le flux de fluide de refroidissement dans une pluralité de directions le long de la deuxième portion près de l'entrée de réactif, le canal d'alimentation en fluide de refroidissement ayant une troisième portion entre la deuxième portion et la sortie de fluide de refroidissement, dans lequel le canal d'alimentation en fluide de refroidissement est établi sur au moins un côté de la plaque de distribution de fluide et la deuxième portion occupe environ un quadrant de la plaque qui inclut un angle de la plaque qui est près de l'entrée de réactif.

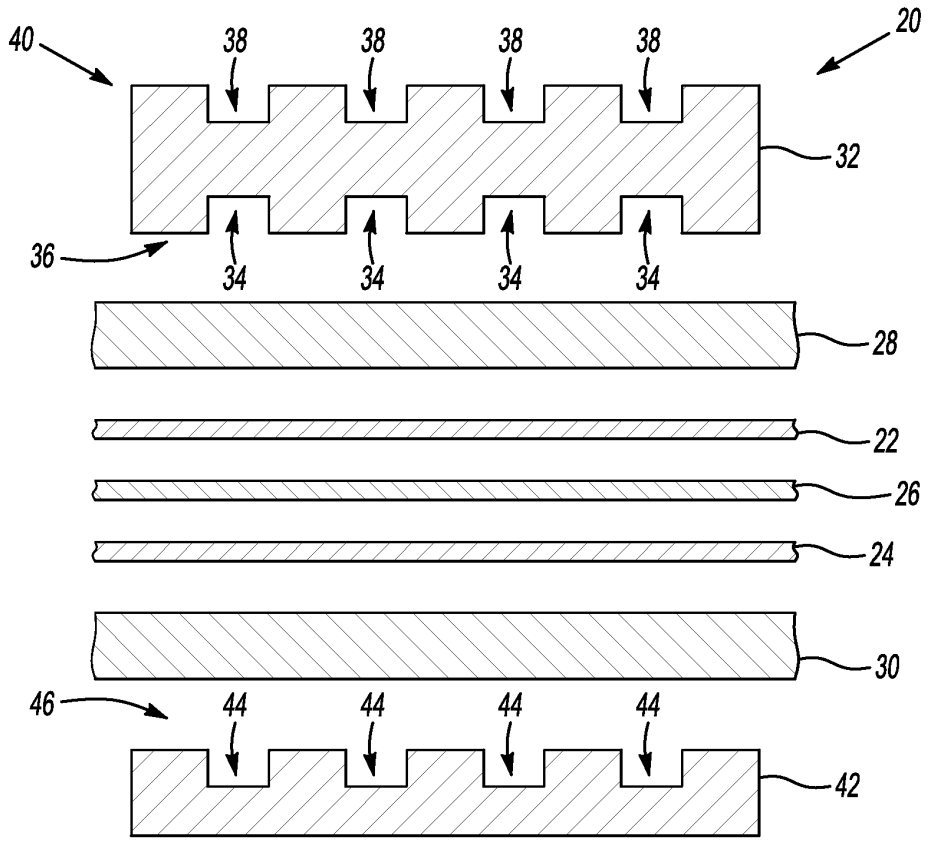

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Fig-1

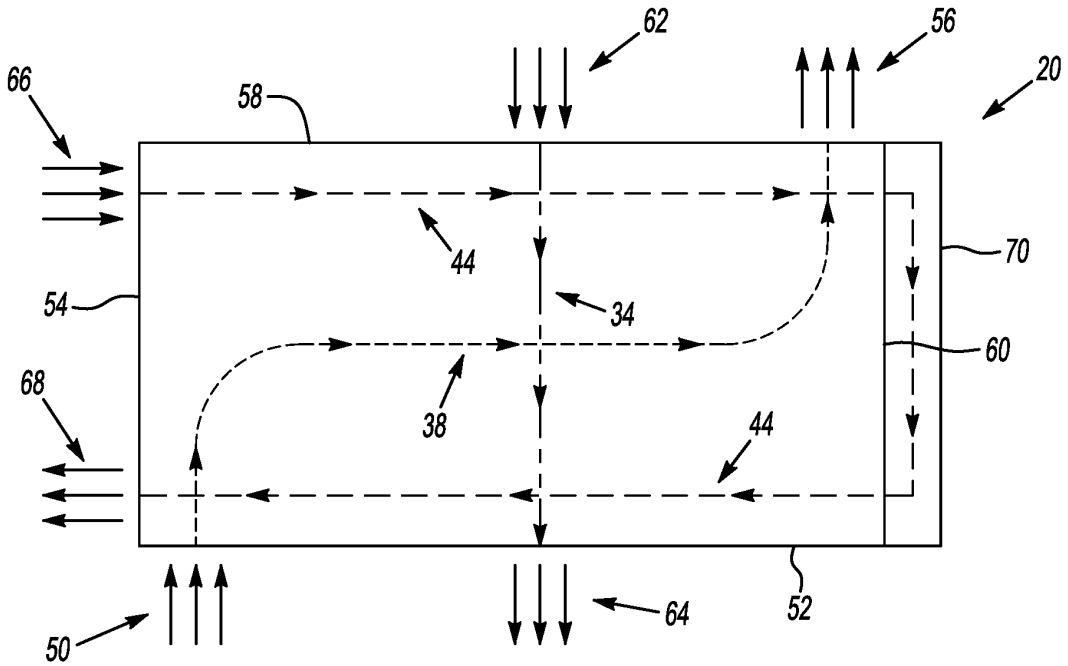

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Fig-2

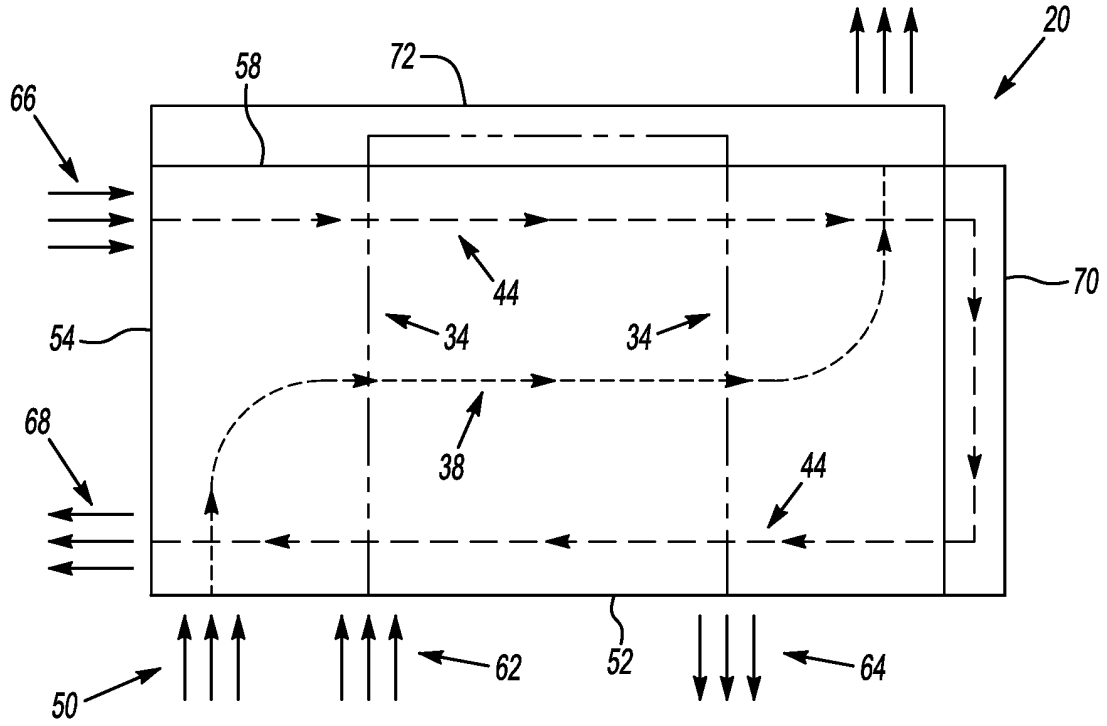

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Fig-3

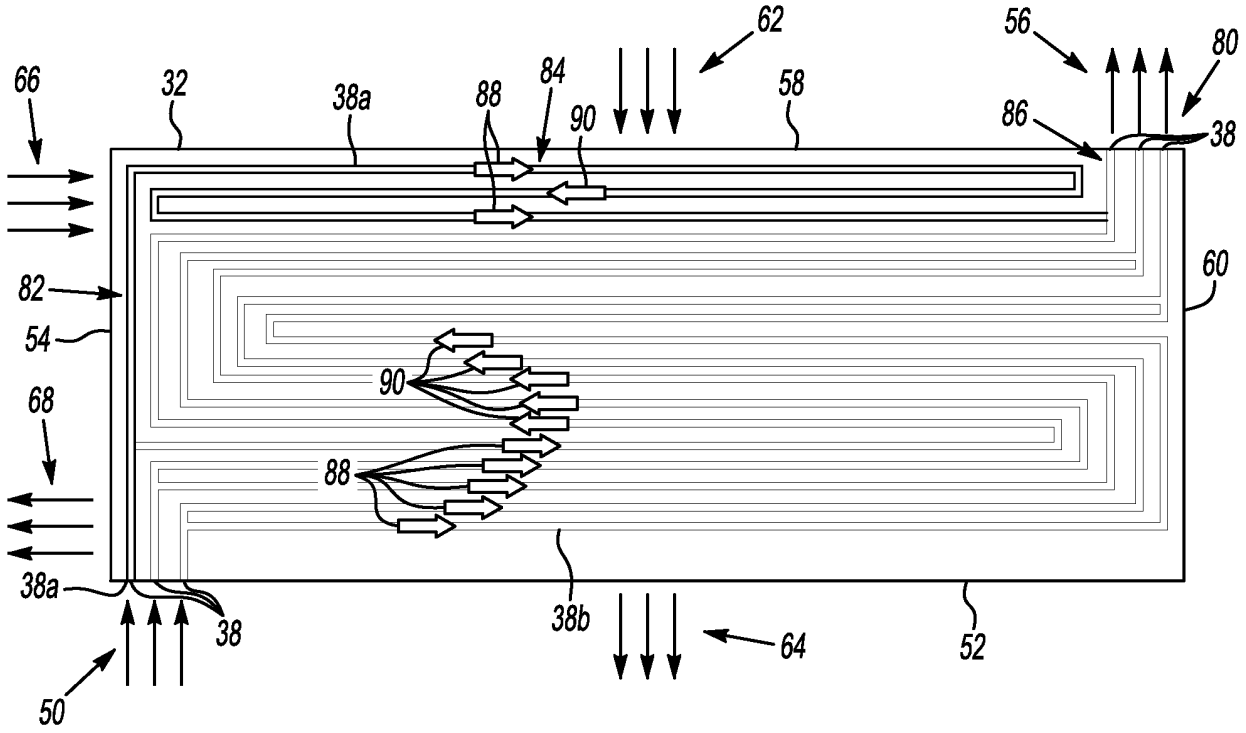

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Fig-4

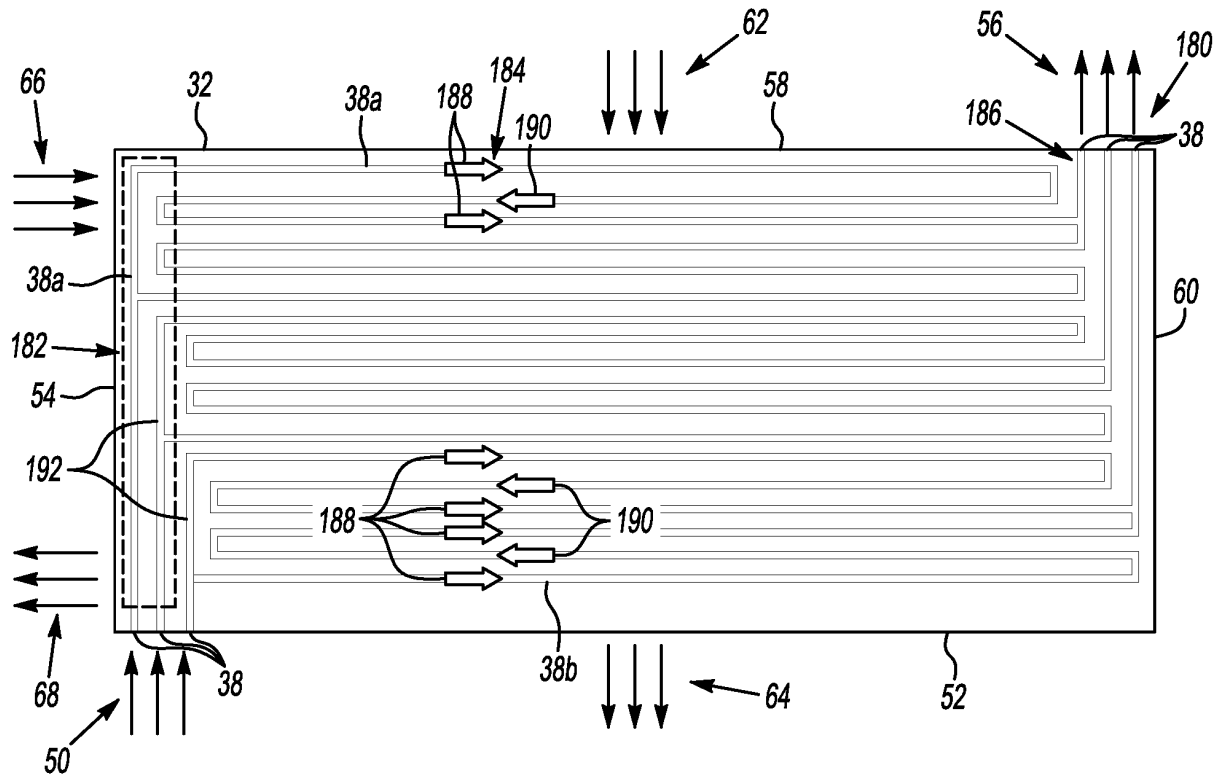

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Fig-5

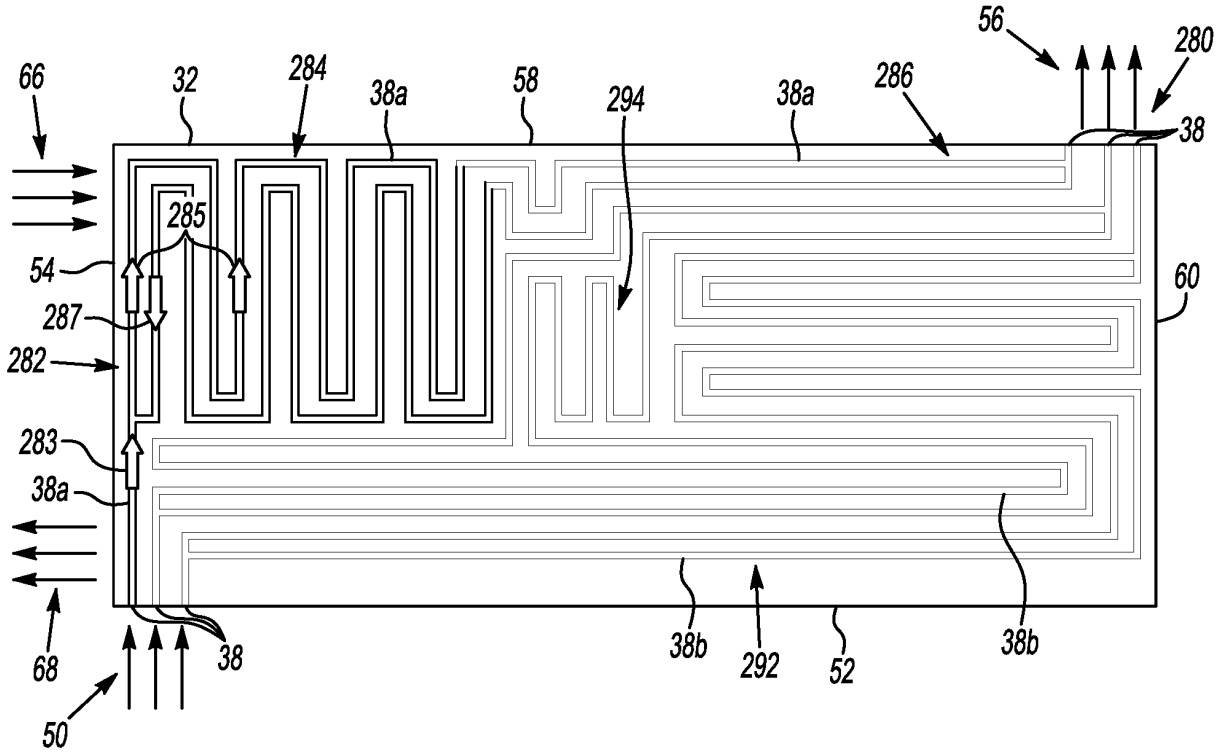

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38b
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38b
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Fig-6